Volume 20 Study G-I-B

STATE OF ALASKA

Jay S. Hammond, Governor

Annual Performance Report for

INVENTORY AND CATALOGING OF THE SPORT FISH AND SPORT FISH WATERS IN SOUTHWESTERN ALASKA

by

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TABLE OF CONTENTS

Study No. G-I INVENTORY AND CATALOGING

Job No. G-I-B Inventory and Cataloging of the Sport Fish and Sport Fish Waters in Southwestern Alaska
By: John Murray and Frank Van Hulle

Volume 20 Study No. G-I-B

RESEARCH PROJECT SEGMENT

State:	ALASKA	Name:	Sport Fish Investigations of Alaska
Project No.:	F-9-11	Study Title:	INVENTORY AND CATALOGING
Study No.:	G-I	Job Title:	Inventory and Cataloging of the Sport Fish and Sport Fish Waters in Southwestern Alaska
Job No.:	G-I-B		

Period Covered: July 1978 to June 30, 1979.

ABSTRACT

Catalog and inventory surveys of 18 Afognak Island lakes determined 15 waters contained natural populations of Dolly Varden, *Salvelinus malma* (Walbaum). Fish were not captured in three lakes so they were considered barren of fish. Lake water chemistry data, physical data, plankton and fish sampling data are presented for the 18 waters studied.

Six Kodiak Island waters were sampled to assess survival growth trends and species composition of rainbow trout, *Salmo gairdneri* Richardson; coho salmon, *Orcorhynchus kisutch* (Walbaum); chinook salmon, *O. tshawytscha* (Walbaum); and Dolly Varden. Fish habitat analysis of American River, Olds River and Roslyn Creek indicated each system respectively contained 29.6, 12.2 and 6.5 surface hectares of fish producing water. Additional habitat characteristics, water chemistry, stream flow, water temperature, and fish sampling data are discussed.

Karluk Lagoon weir escapement was composed of 1,052 steelhead kelts, *Salmo gairdneri* Richardson; 9,795 chinook salmon; 12,089 coho salmon; 1.38 million pink salmon, *O. gorbuscha* (Walbaum); 0.36 million sockeye salmon, *O. nerka* (Walbaum); and 948 upmigrant steelhead. Six of 254 tagged steelhead kelts returned to the river after 15 months marine residence. Age-growth data for Karluk steelhead and chinook salmon and a summary of the weir count is presented.

A downstream migrant fish trap on Lake Genevieve fish barrier was operated from May 15 to July 9. Timing, size and age of all fish migrants are discussed. An estimated 300 adult sockeye migrated into the lake during August and September.

Chinook salmon smolt (n=14,261, $\bar{x}$ wt. = 10.4 g, $\bar{x}$ ln. = 98.5 mm) stocked in Lake Rose Tead June 2 should return with the 1978 plant (n=133,109 fry) as adults in 1981 and 1982.

Salmon escapement counts indicated approximately 280,630 pink salmon; 17,650 chum salmon, *O. keta* (Walbaum); 28,301 sockeye salmon; and 6,007 coho salmon spawned in 17 northeast Kodiak Island streams during 1978.

BACKGROUND

The primary objective of Sport Fish Division projects in Region IV is to optimize the survival and growth of resident and stocked game fish and to maintain the natural runs of anadromous fish.

Region IV is the Kodiak-Afognak Island group and the Alaska Peninsula, south of a line from Cape Douglas to Port Heiden, including the Aleutian Islands. The Kodiak complex (Figure 1) is approximately 200 km long by 120 km wide (124 mi long by 75 mi wide) and the Alaska Peninsula section is 1,600 km (994 mi) long extending 800 km (497 mi) into the Bering Sea. The area is mountainous, with numerous bays, lakes and streams, containing anadromous and resident fish. Much of the area has not been surveyed and the total number of fish producing waters is unknown. Kodiak Island has over 1,609 km (1,000 mi) of coastline, over 1,000 lakes 4 ha (10 a) or larger in size, and 229 known anadromous fish streams.

The fish stocking program was initiated in 1953 and has continued to the present; however, in order to develop more successful programs, numerous lakes have been chemically rehabilitated and various fish species have been stocked at differential rates. Different sizes of fish have been tested, and various habitat conditions have been studied to optimize growth and survival.

The physical and biological condition of lakes on northeast Kodiak Island has been examined in some detail and the results of these observations are shown in the annual Federal Aid in Fish Restoration Report 1953-1978. Priority for research, stocking, and general survey work has been centered on the areas of intensive sport fishing effort and on areas where specific data are required to evaluate anticipated land use programs or development activities. Past stream research has centered on waters with steelhead, rainbow trout, coho salmon and chinook salmon; however, increases in fishing effort indicate that these studies should be intensified. This report presents specific stream temperature, flow, water chemistry and related data which will form the basis for identifying programs to determine carrying capacity and areas of critical habitat for salmon, Dolly Varden and trout.

The Federal Aid in Fish Restoration Report for the Kodiak area from 1953 to the present depicts specific data concerning the size, age and growth of coho, Dolly Varden, chinook, sockeye, and steelhead from the Kodiak area. Additional data concerning harvest rates and spawning escapement are presented.

These data form the foundation for most management decisions concerning sport fish regulations and land use activities in the Kodiak area.

Figure 1. Map of the Kodiak-Afognak Island Group.

Scale 1: 1,250,000

Table 1 presents a list of the fishes observed or studied in this report.

RECOMMENDATIONS

1. The creel census on Buskin and Pasagshak rivers should be continued as needed to determine angler effort and harvest of Dolly Varden and salmon.

2. The postal survey should be continued to determine sport harvest and angler effort on Kodiak and Afognak Islands.

3. The fish producing waters on Afognak Island that will remain as public waters following total implementation of the Alaska Native Claims Settlement Act should be surveyed and inventoried.

4. Survival, growth, and quality of fishing produced by various races and species of stocked fish should be evaluated.

5. The Karluk Lagoon weir should be maintained until approximately November 15, 1980, and the affect of this weir on steelhead movements and survival evaluated.

6. Weir sites should be selected on one lake and one non-lake stream system on north-eastern Kodiak Island, and a study developed to determine the salmonid carrying capacity of these waters.

OBJECTIVES

1. To determine the physical, chemical and biological characteristics of existing and potential sport fishing streams and lakes in the Kodiak area.

2. To establish magnitude, distribution, timing, yearly fluctuations and angler harvest of sport fish populations on Kodiak Island, Afognak Island, and areas of concern to sport fisheries management on the Alaska Peninsula.

3. To investigate, evaluate, and develop plans for the enhancement of anadromous and resident fish stocks.

TECHNIQUES USED

Techniques described by Murray and Van Hulle (1978) were used in lake surveys, gillnet sampling, age analysis, determination of fish size, escapements and fish harvest estimates.

Table 1. List of Common Names, Scientific Names and Abbreviations Used in this Report.

Common Name	Scientific Name & Author	Abbreviations
Arctic grayling	*Thymallus arcticus* (Pallas)	GR
Chinook salmon	*Oncorhynchus tshawytscha* (Walbaum)	KS
Chum salmon	*Oncorhynchus keta* (Walbaum)	CS
Coho salmon	*Oncorhynchus kisutch* (Walbaum)	SS
Dolly Varden	*Salvelinus malma* (Walbaum)	DV
Pink salmon	*Oncorhynchus gorbuscha* (Walbaum)	PS
Rainbow trout	*Salmo gairdneri* Richardson	RT
Sculpin	*Cottus sp.*	Sc
Slimy sculpin	*Cottus cognatus* Richardson	SSC
Sockeye salmon	*Oncorhynchus nerka* (Walbaum)	RS
Steelhead	*Salmo gairdneri* Richardson	SH
Threespine stickleback	*Gasterosteua aculeatus* Linnaeus	TST

Fish caught in the traps were anesthetized, counted and sampled for age-growth data. Scale samples were removed from all rainbow-steelhead and randomly from 100 coho salmon; otoliths were removed from a random sample of 100 Dolly Varden. No attempt was made to statistically sample sculpin or stickleback for length or age data.

The estimated number of juvenile Dolly Varden and coho salmon needed for size-age analysis was determined by computing the variance of fish sampled from a respective stream in 1977 and employing the statistical formula (Cochran and Snedecor, 1967):

$$n = \frac{4Q^2}{L^2}$$

n = sample size
Q^2 = sample variance
L = allowable error

Sample sizes were based on $\pm$ 2 mm error of the mean.

Temperature for Kodiak Island streams was monitored with Ryan Model H-15 recording thermographs placed near the stream terminus, above tidal influence.

Flow was determined by the formula (Manning 1890):

$$Q = A \cdot \frac{1.486}{n} \cdot R\ 2/3 \cdot s\ 1/2$$

where

Q = discharge in cu. m. per sec. = design discharge
A = cross-sectional area of flow in sq m
n = coefficient of roughness
R = hydraulic radius = mean depth
s = slope, or ratio of the vertical fall to the length

Cross-sectional area of flow (A) and the stream bed area (well above high water mark) were measured at highway bridge crossings. Height of stream flow was measured monthly from the top of respective bridges to estimate cross-sectional area of flow throughout the year.

Gurley flow readings were conducted concurrently with initial area measurements to determine n (coefficient of roughness):

$$n = \frac{1.486 \cdot R2/3 \cdot s\ 1/2}{\text{velocity (m/s)}}$$

Fish habitat and stream drainage characteristics were determined by measuring stream width, depth, pools, riffles, bed composition, bank stability and stream side vegetation. These measurements were made at 50, 100, or 200 meter (55,109 or 219 ft) intervals along a transect

across the stream at right angles to its centerline. Transects were generally at 50 meter intervals on short streams (less that 1:5 kilometers in length) and at 200 meter intervals on the main channel. Transects commenced at the stream terminus (above mean high tide) and continued until all fish producing waters had been surveyed. A field data collection form is presented in Figure 2, and Tables 2 and 3 show the criteria used for classifying pools, riffles and banks. These criteria are similar or identical to those originated by Herrington and Dunham (1967) and Thomas (1975).

FINDINGS

Results

Lake and Stream Surveys:

Lake surveys during 1978 determined the physical, chemical and biological characteristics of 16 unnamed lakes on Afognak Island (Figure 3) and collected additional information on Waterfall Lake and Delphin Bay Lake No. 13566. During 2,595.5 hours of gill-netting and minnow trapping, an aggregate of 1,103 Dolly Varden, 552 threespine stickleback, 80 juvenile coho salmon, and 32 sculpin were captured in 15 of 18 waters sampled (Table 4). Dolly varden were present in all fish producing waters while threespine stickleback, sculpin, and juvenile coho salmon were respectively captured in only three, two and one of the waters studied. Fish were not captured or observed in three unsurveyed lakes and it is assumed they are barren of fish.

Age-growth data presented in Tables 4 and 5 indicate the Dolly Varden sampled were Age Classes II through IX with a respective mean length range of 72-510 mm. Juvenile coho salmon (n=80) captured in Big Waterfall Creek were age 0.0 (n=61) and 1.0 (n=19) with respective mean lengths of 63 mm and 106 mm.

Physical and chemical characteristics of the above waters,, as presented in Tables 6 and 7, indicate surface area, surface temperature and maximum depth respectively, ranged from 2.8 to 171.6 ha (6.9 to 423 a) 11.5^{o} to 18.5^{o}C (527^{o} to 65.3^{o}F) and 1.8 to 42.7 m (6 to 140 ft) Total water hardness ranged from 0 to 15 ppm and total alkalinity ($CaCO_3$) ranged from 4 to 26 ppm. The zooplankton data, presented in Table 8, show the density of invertabrates per cubic meter for all waters sampled was 2,922 to 53,820 cladocera, 2,070 to 49,627 copepoda and 1,155 to 17,387 rotifera.

American River, Olds River, and Roslyn Creek (Figure 4) fish habitat and stream drainage characteristics presented in Table 9 indicate respective channel lengths of 31.1 km (19.3 mi), 16.1 km (10 mi), and 12.5 km (7.8 mi). The American River contained 29.6 surface hectares (73 a) composed of 37.2% pool and 62.8% riffle with a mean depth of 32.0 cm (12.6 in). Olds River contained 12.2 surface hectares (30 a) 44.6% pool and 55.4% riffle, with a mean depth of 29.0 cm (11.4 in). Roslyn Creek contained

DRAINAGE _____ PAGE _____

SAMPLE NO. _____ FIELD CREW _____

DATE _____

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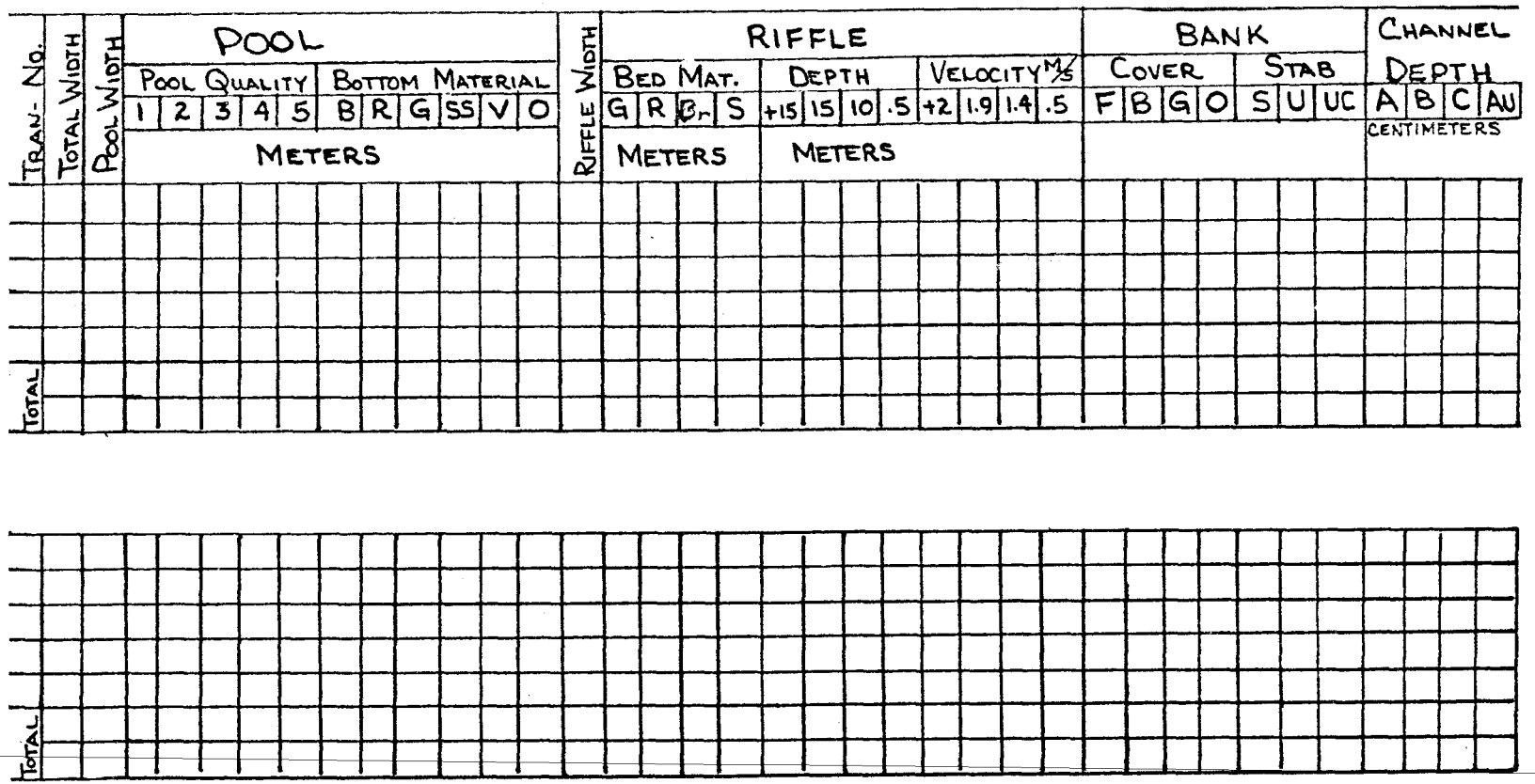


COMMENTS: _____

Figure 2. Field Data Collection Form.

Table 2. Guide to Classification of Stream Bed Material, Riffle Depth, Riffle Velocity, Bank Cover and Bank Stability Used in Table.

Quality Class	Definition
Stream Bed Material	
Br (Bedrock)	Solid Rock
B (Boulder)	Rocks over 30.5 cm in diameter
R (Rubble)	Rocks 7.5 to 30.5 cm in diameter
G (Gravel)	Gravel 0.25 to 7.4 cm in diameter
S (Silt)	Particles less than 0.25 cm in diameter
V (Vegetation)	Moss, grass, etc.
O (Other)	Sunken logs, debris, etc.
Riffle Depth	
1	Over 15 cm deep
2	11-15 cm deep
3	6-10 cm deep
4	0-5 cm deep
Riffle Velocity	
1	0.60 to 0.90 m/s
2	0.45 to 0.50 m/s
3	0.15 to 0.44 m/s
4	less than 0.15 m/s
Bank Cover	
F (Forest)	Based on a subjective judgement of the predominant cover type over a 100-meter square area at the end of each transect above high-water mark.
B (Brush)	
G (Grass)	
O (Open)	
Bank Stability	
S (Stable)	No sign of errosion within one year
U (Unstable)	Visable errosion within one year
UC (Undercut)	Stream bank overhangs water
Channel Depth	Stream depth measured at quarter intervals across the stream in centimeters

Table 3. Guide to the Classification of Pool Quality used in Figure 2.

Quality Class No.	Length or Width	Depth	Shelter*
1	Greater than a.c.w.**	2 ft or deeper	Abundant***
	Greater than a.c.w.	3 ft or deeper	Exposed****
2	Greater than a.c.w.	2 ft or deeper	Exposed*****
	Greater than a.c.w.	2 ft or deeper	Intermediate
	Greater than a.c.w.	2 ft	Abundant
3	Equal to a.c.w.	2 ft	Intermediate
	Equal to a.c.w.	2 ft	Abundant
4	Equal to a.c.w.	Shallow******	Exposed
	Less than a.c.w.	Shallow	Abundant
	Less than a.c.w.	Shallow	Intermediate
	Less than a.c.w.	2 ft	Intermediate
	Less than a.c.w.	2 ft or deeper	Abundant
5	Less than a.c.w.	Shallow	Exposed

* Logs, stumps, boulders, and vegetation in or overhanging pool, or overhanging banks
** Average channel width
*** More than one-half perimeter of pool has cover
**** Less than one-fourth of pool perimeter has cover
***** One-fourth to one-half perimeter of pool has cover
****** Approximately equal to average stream depth

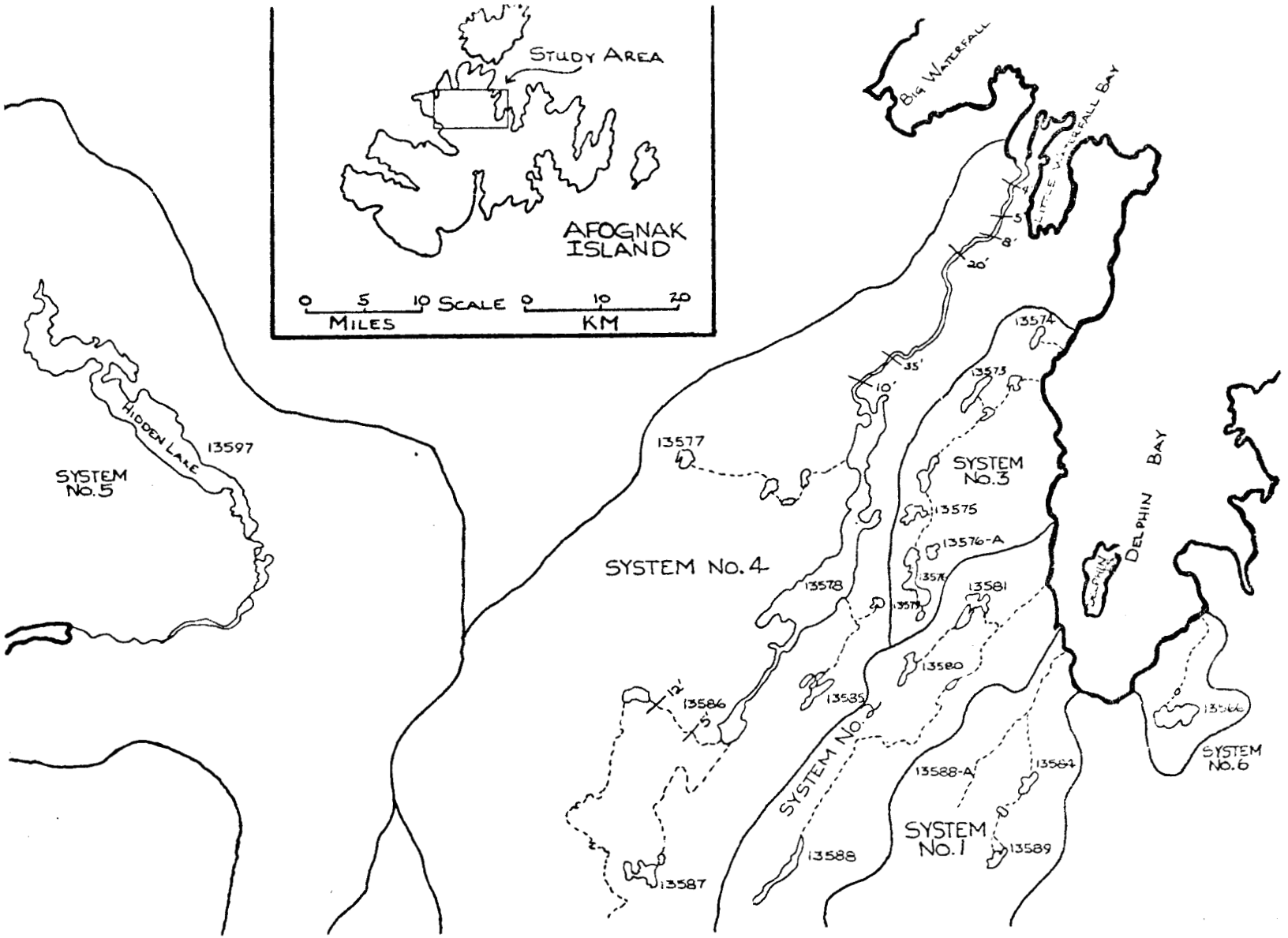


Figure 3. Lakes on Afognak Island.

Table 4. Fish Sampling Summary of Afognak Island Lakes, 1978.

Lake Name & Location	System	Date Sampled	Species*	Number	Age	Length (mm) $\bar{x}$	Length (mm) ±SD	Weight (g) $\bar{x}$	Weight (g) ±SD	Net Hrs.	Trap Hrs.
13589 T21S,R20W Sec. 35	1	Sept. 13	None							45.0	0.0
13584 T21S,R20W Sec. 26	1	Sept. 12	DV	3	II	118	9.2	20(n=1		...	...
			DV	13	III	155	24.8	51.1	16.2	...	...
			DV	14	IV	206	18.5	88.5	21.7		
			DV	1	V	242	0.0	129.0	0.0	0.0	0.0
13588 T21S,R20W Sec. 33	2	Sept. 5	DV	1	II	98	0.0	0.0	0.0	0.0	6.0
			DV	25	III	131	14.7	...	...	...	...
13580 T21S,R20W Sec. 22	2	Aug. 22	None							43.0	86.0
13581 T21S,R20W Sec. 23	2	Aug. 22	None							44.0	88.0
13579 T21S,R20W Sec. 22	3	Aug. 14	DV	20	III	161	27.1	104.8	62.4	21.0	63.0
			DV	28	IV	231	16.7	135.1	28.6	...	...
			DV	10	V	283	13.9	247.9	29.4	...	...
			DV	2	VI	350	14.1	448.0	161.2	...	...
13576 T21S,R20W Sec. 15	3	Aug. 21	DV	3	II	101	4.0	10.7	2.0	44.0	86.0
			DV	16	III	161	26.9	53.9	29.0	...	...
			DV	34	IV	245	27.1	165.2	54.8	...	...
			DV	14	V	286	15.9	243.9	47.8	...	...
			DV	2	VI	334	7.8	336.0	19.8	...	...

Table 4. (Cont.) Fish Sampling Summary of Afognak Island Lakes, 1978.

Lake Name & Location	System	Date Sampled	Species*	Number	Age	Length (mm) $\bar{x}$	Length (mm) ±SD	Weight (g) $\bar{x}$	Weight (g) ±SD	Net Hrs.	Trap Hrs.
13576-A	3	Aug. 25	DV	7	II	72	5.1	...	...	4.5	18.0
T21S,R20W			DV	18	III	183	15.8	61.0	11.7	...	...
Sec. 15			DV	4	IV	201	1.4	76.8	3.4	...	...
Common Outlet	3	Aug. 25	DV	6	II	120	13.7	...	...	18.0	0.0
to 13576 &			DV	2	III	163	21.9	...	...	...	...
13575											
13575	3	Aug. 14	DV	2	II	99	12.0	7.8	4.6	46.0	69.0
T21S,R19W			DV	9	III	187	6.3	66.4	6.2	...	...
Sec. 15			DV	52	IV	238	20.4	142.4	47.4	...	...
			DV	5	V	306	34.1	267.4	30.7	...	...
				1	VI	379	...	529.0	...	...	...
13573	3		DV	3	III	173	7.8	56.3	2.1	47.0	71.0
T21S,R20W			DV	3	IV	247	35.7	189.3	76.1	...	...
Sec. 11			DV	5	V	327	15.5	522.8	212.7	...	...
			DV	3	VI	437	27.5	938.7	79.1	...	...
			TST	365	...	...	...	...	...	...	...
13574	3	Aug. 28	None							43.0	64.5
T21S,R20W											
Sec. 2											
13587	4	Sept. 5	DV	4	III	175	24.5	...	...	11.0	16.5
T21S,R20W			DV	5	IV	215	4.7	...	...	...	...
Sec. 32											
13586	4	Sept. 7	DV	2	II	86	12.0	...	...	0.0	30.0
T21S,R20W			DV	5	III	134	8.3	...	...	...	...
Sec. 28			Sc	7	...	...	...	...	...	...	...
			TST	50	...	...	...	...	...	...	...

Table 4. (Cont.) Fish Sampling Summary of Afognak Island Lakes, 1978.

Lake Name & Location	System	Date Sampled	Species*	Number	Age	Length(mm) $\bar{x}$	Length(mm) ±SD	Weight (g) $\bar{x}$	Weight (g) ±SD	Net Hrs.	Trap Hrs.
13585 T21S,R20W Sec. 28	4	Aug. 21	None							43.0	86.0
13577 T20S,R20W Sec. 8	4	Aug. 27	None							3.0	9.0
13578 T21S,R20W Sec. 21	4	June 22	DV(F)	46	III	134	15.7	10.7	25.9	378.0	0.0
			DV(F)	119	IV	207	18.7	90.1	27.5	...	...
			DV(F)	51	V	246	19.9	146.0	33.7	...	...
			DV(F)	6	VI	289	15.0	217.8	19.2	...	...
			DV(F)	1	VII	360	...	...	...	...	...
Main Lake Area			DV(M)	53	III	146	25.1	38.0	19.7	...	...
			DV(M)	76	IV	206	28.8	93.0	21.0	...	...
			DV(M)	80	V	253	13.8	156.3	26.1	...	...
			DV(M)	19	VI	306	27.3	297.7	97.5	...	...
			DV(M)	5	VII	470	22.7	346.3	789.3	...	...
			DV(M)	1	VIII	423	...	1011	0.0	0.0	0.0
			DV(M)	1	IX	510	...	1376	0.0	0.0	0.0
Above 35 ft Falls			DV	11	II	91	5.0	...	...	0.0	343.0
			DV	60	III	126	12.5	...	...	...	...
			Sc	1	...	...	...	...	...	...	...
			TST	2	...	...	...	...	...	...	...
Between Lakes 13578 & 13576			DV	5	II	87	9.5	...	...	0.0	125.0
			DV	10	III	131	15.7	...	...	...	...
			Sc	15	...	64	8.6	...	...	...	...
			TST	7	...	...	...	...	...	...	...

Table 4. (Cont.) Fish Sampling Summary of Afognak Island Lakes, 1978.

Lake Name & Location	System	Date Sampled	Species*	Number	Age	Length(mm) $\bar{x}$	Length(mm) ±SD	Weight (g) $\bar{x}$	Weight (g) ±SD	Net Hrs.	Trap Hrs.
Below 12 ft		June 22	DV	20	II	84	...	...	...	0.0	355.0
Falls on			DV	36	III	131	17.8	...	...	...	...
Inlet			Sc	5		74	1.7	...	...	...	...
			TST	34		...	...	...	...	...	...
Above 12 ft		June 22	DV	34	II	34	8.7	...	...	0.0	148.0
Inlet Falls			DV	97	III	97	19.4	...	...	...	...
Lake		Aug. 13	DV	2	II	90	19.0	...	...	0.0	72.0
			DV	12	III	135	20.5	...	...	...	...
			TST	86		...	...	...	...	...	...
			Sc	4		...	...	...	...	...	...
Below 35 ft		Aug. 25	DV	12	II	91	10.2	...	...	0.0	20.0
Falls			DV	55	III	130	15.5	...	...	...	...
			TST	8		...	...	...	...	...	...
			SS	61	0+.0	63	4.8	...	...	...	...
			SS	19	1+.0	106	19.1	...	...	...	...
13957	5	Sept. 21	DV	6	II	108	18.6	...	...	126.0	125.0
				35	III	159	27.2	46.5	20.8	...	...
				56	IV	195	29.0	73.0	31.2	...	...
				25	V	227	24.2	110.1	37.9	...	...
				1	VI	398	...	669	...	...	...
				2	VII	429	5.7	656	62.2	...	...

Table 4. (Cont.) Fish Sampling Summary of Afognak Island Lakes, 1978.

Lake Name & Location	System	Date Sampled	Species*	Number	Age	Length(mm) $\bar{x}$	Length(mm) ±SD	Weight (g) $\bar{x}$	Weight (g) ±SD	Net Hrs.	Trap Hrs.
13566	6	Aug. 8	DV	4	II	84.3	11.1	...	...	63.0	64.0
			DV	18	III	143.5	26.7	...	...	...	...
			DV	8	IV	270.3	59.9	246.8	93.8	...	...
			DV	4	V	334.0	29.3	...	...	...	...
			DV	1	VI	400	...	...	...	...	...

* DV = Dolly Varden
TST = Threespine stickleback
Sc = Sculpin
SS = Coho salmon

(F) Female
(M) Male

Table 5. Size by Age Class of Dolly Varden Sampled on Afognak Island between August 12 and September 12, 1978.

Age Class	Number	Mean Length (mm)	Range of Mean Lengths (mm)
II	48	96	72-120
III	238	149	101-187
IV	204	224	195-270
V	64	270	227-334
VI	10	346	334-437
VII	2	429	429

Table 6. Physical Characteristics of Lakes Surveyed on Afognak Island, 1978.

Lake Number & Location	System	Date	Surface Temp/°C	°F	Elev. (m)	(ft)	Surface Area(ha)	(ac)	Maximum Depth(m)	(ft)
13589 T21S,R20W Sec. 35	1	Sept. 13	11.5°	(53°)	180	(590)	3.4	(8.4)	10.7	(35.1)
13584 T21S,R20W Sec. 26	1	Sept. 12	12.0°	(53.6°)	74	(243)	4.4	(10.9)	7.3	(24.0)
13588 T21S,R20W Sec. 33	2	Aug. 31	*		107	(351)	7.1	(17.5)	*	
13580 T21S,R20W Sec. 22	2	Aug. 17	17.0°	(62.6°)	107	(351)	4.1	(10.1)	4.6	(15.1)
13581 T21S,R20W Sec. 23	2	Aug. 15	18.0°	(64.4°)	61	(200)	10.8	(26.7)	2.3	(7.5)
13579 T21S,R20W Sec. 22	3	Aug. 14	16.5°	(61.7°)	137	(449)	3.2	(7.9)	7.3	(24.0)
13576 T21S,R20W Sec. 15	3	Aug. 13	16.5°	(61.7°)	137	(449)	8.9	(22.0)	10.3	(33.8)
13576-A T21S,R20W Sec. 15	3	Aug. 25	18.0°	(64.4°)	137	(449)	2.8	(6.9)	2.4	(7.9)

Table 6. (Cont.) Physical Characteristics of Lakes Surveyed on Afognak Island, 1978.

Lake Number & Location	System	Date	Surface Temp/°C	°F	Elev. (m)	(ft)	Surface Area(ha)	(ac)	Maximum Depth(m)	(ft)
13575 T21S,R20W Sec. 15	3	Aug. 13	17.0°	(62.6°)	91	(399)	5.1	(12.6)	10.3	(33.8)
13573 T21S,R20W Sec. 11	3	Aug. 28	13.0°	(55.4°)	76	(249)	4.2	(10.4)	12.2	(40.0)
13574 T21S,R20W Sec. 2	3	Aug. 28	14.0°	(57.2°)	46	(151)	3.1	(7.7)	8.5	(27.9)
13587 T21S,R20W Sec. 32	4	Aug. 31	12.8°	(55.8°)	119	(390.0)	8.1	(20.0)	6.1	(20.0)
13586 T21S,R20W Sec. 28	4	Aug. 19	18.0°	(64.4°)	84	(275.6)	10.9	(27.0)	1.8	(5.9)
13585 T21S,R20W Sec. 28	4	Aug. 17	16.5°	(61.7°)	145	(475.0)			7.3	(24.0)
13577 T21S,R20W Sec. 8	4	Aug. 27	15.0°	(59.0°)	457.2	(1,500.0)	5.3	(13.1)	23.8	(78.1)
13578 T21S,R20W Sec. 10	4	June 22 Aug. 28	16.0°	(60.8°)	74	(242.8)	109.3	(270.0)	19.8	(65.0)

Table 6. (Cont.) Physical Characteristics of Lakes Surveyed on Afognak Island, 1978.

Lake Number & Location	System	Date	Surface Temp/°C	°F	Elev. (m)	(ft.)	Surface Area(ha)	(ac)	Maximum Depth(m)	(ft.)
13597 T21S,R21S Sec. 14	5	Sept. 21	11.5°	(50.9°)	69	(226.4)	171.6	(424.0)	42.7	(140.0)
13566	6	Aug. 8	18.5°	(65.3°)	49	(160.8)	13.0	(32.1)	9.1	(29.9)

* Measuring Equipment Inoperative

Table 7. A Summary of Water Chemistry Observation For Lakes Surveyed on Afognak Island, 1978.

Lake Number	System	Date	Water Temp. °C	(F°)	Air Temp. °C	(°F)	Total*** Hardness ppm	Total*** Alkalinity ppm	pM	Remarks
13589	1	Sept. 12	12.0	(53.6)	10.0	(50.0)	13.0	21	6.4	
13584	1	Sept. 13	11.5	(51.7)	8.0	(46.4)	9.0	17	6.5	
13588	2		*		**					
13580	2	Aug. 17	17.0	(62.6)	**		11.0	17	6.4	
13581	2	Aug. 14	18.0	(64.4)	**		10.0	16	6.3	12ppm D.O.
13579	3	Aug. 14	16.5	(61.7)	**		10.0	16	6.4	
13576	3	Aug. 13	16.5	(61.7)	**		9.0	13	6.5	
13576-A	3	Aug. 26	18.0	(64.4)	19.0	(66.2)	12.0	18	6.4	
13575	3	Aug. 13	17.0	(62.6)			8.0	10	6.3	
13573	3	Aug. 28	13.0	(55.4)	12.0	(53.6)	13.0	20	6.5	
13574	3	Aug. 28	14.0	(57.2)	17.0	(62.6)	15.0	26	6.5	
13587	4	Aug. 31	12.0	(53.6)	15.0	(59.0)	4.0	10	6.3	
13586	4	Aug. 19	18.0	(64.4)	**		13.0	23	6.4	
13585	4	Aug. 17	16.5	(61.7)	**		6.0	11	6.2	
13577	4	Aug. 28	15.0	(59.0)	15.0	(59.0)	0.0	4	6.3	High Alpine
13578	4	Aug. 12	16.0	(60.8)	**		11.5	18	6.5	
13597	5	Sept. 21	11.5	(52.7)	9.0	(48.2)	5.0	11	6.1	Average of 3 Samples
13566	6	Aug. 8			**		15.0	13	6.5	

* Unable to reach lake with sampling equipment
** Thermometer broken
*** $CaCO_3$

Table 8. A Summary of Plankton Samples, Afognak Island Lakes, 1978.

Lake Number	System	Depth(m) at Station	(ft)	Date	Organisms/Meter^{3*} Cladocera	Copepoda	Rotifera	Phyto
13589	1	7.0	(33.0)	Sept. 13	...	8,639	2,159	Light
13584	1	6.1	(22.0)	Sept. 12	...	24,618	...	"
13588	2							
13580	2	2.7	(8.9)	Aug. 18	...	49,627	...	Light
13581	2	0.9	(3.7)	Aug. 15	...	16,556	...	"
13579	3	5.2	(17.1)	Aug. 14	37,989	5,845	...	Light
13576	3	7.3	(24.0)	Aug. 13	53,820	8,280	2,070	"
13576-A	3	0.9	(30.0)	Aug. 26	...	33,113	...	"
13575	3	7.3	(24.0)	Aug. 13	12,419	2,070	...	"
13573	3	8.8	(28.9)	Aug. 28	6,852	...	13,703	"
13574	3	7.0	(23.0)	Aug. 28	...	4,338	...	"
13587	4	5.2	(17.1)	Aug. 31	2,922	14,611	...	Light
13586	4	...		...	...	...	...	...
13585	4	5.8	(19.0)	Aug. 17	...	2,615	...	Light
13577	4	15.8	(51.8)	Aug. 27	3,821	2,866	...	"
13578	4	13.1		Aug. 12	5,776	4,621	1,155	"
		13.1		...	...	3,465	...	"
		7.3	(24.0)	...	8,278	4,139	...	"
13597	5	18.3	(60.0)	Sept. 20	4,140	6,624	17,387	Light
		18.3	(60.0)	...	4,140	13,248	...	"
		10.7	(35.1)	...	4,258	14,192	9,935	"
13566	6	3.2	(10.5)	Aug. 8**	3,120	...	7,187	Moderate
		3.2	(10.5)	...	6,250	12,500	6,250	"
		7.8	(25.6)	...	7,730	...	4,510	"

* $0.33M^2$ Net, 10 Micron Porosity
** $0.5M^2$ Net, 25 Micron Porosity

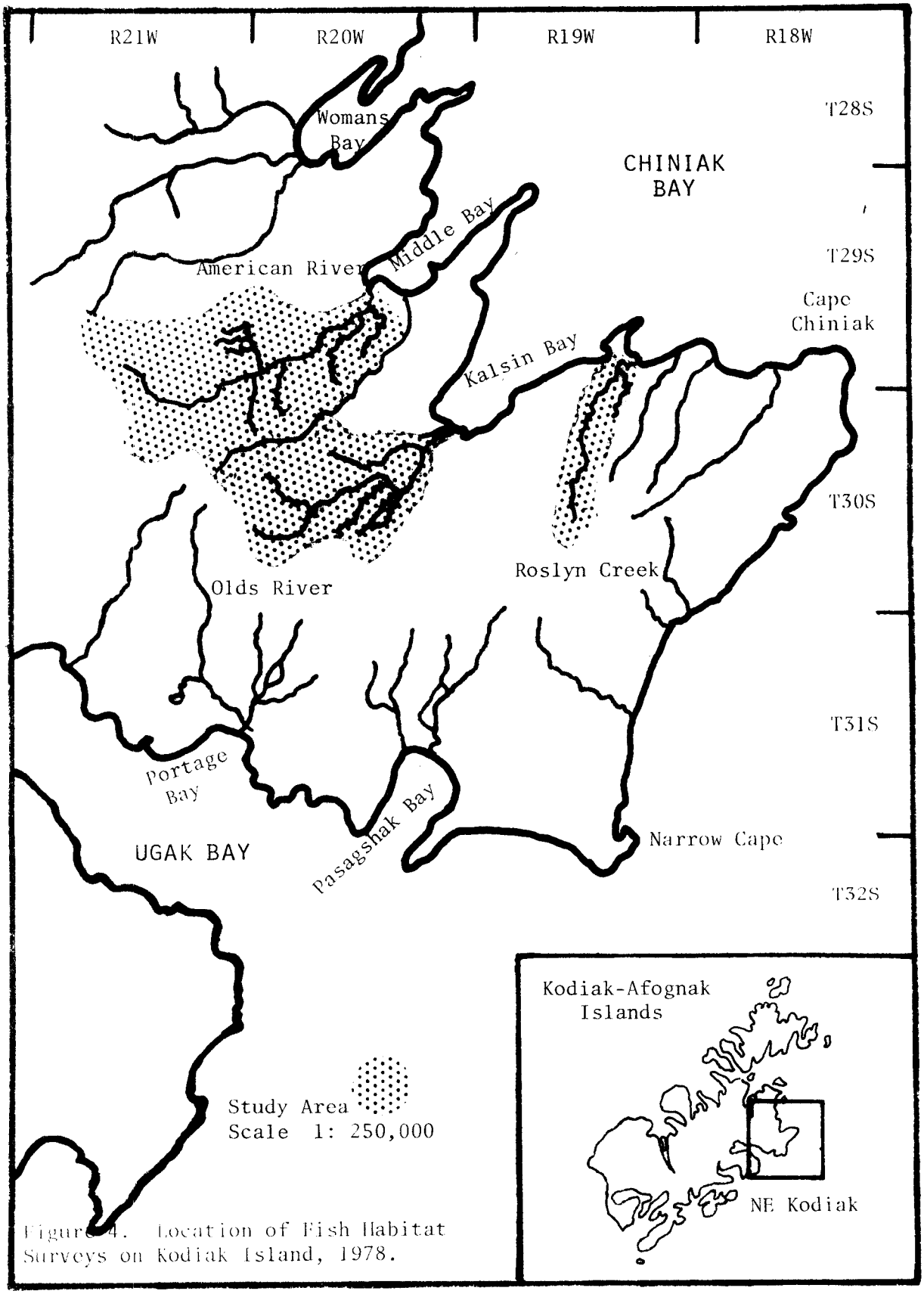


Figure 4. Location of Fish Habitat Surveys on Kodiak Island, 1978.

	American River			Olds River			Roslyn Creek		
	Main Channel	Tributary Channels	Total	Main Channel	Tributary Channels	Total	Main Channel	Tributary Channels	Total
Number of Transects	51	300	351	83	78	161	31	53	84
Stream Length ---------- kilometers	10.2	20.9	31.1	8.3	7.8	16.1	7.2	5.3	12.5
Average Width ---------- meters	20.5	4.1	9.2	10.8	4.1	7.6	6.6	5.3	5.1
Surface Area ---------- hectares	20.9	8.6	29.5	9.0	3.2	12.2	4.8	1.8	6.5
Average Depth ---------- centimeters	33.0	30.0	32.0	37.0	21.0	29.0	24.0	20.0	22.0
Pool Area ---------- percent	21.5	72.1	37.2	35.7	69.4	44.6	62.5	62.2	62.4
Riffle Area ---------- percent	78.5	27.9	62.8	64.3	30.6	55.4	37.5	37.8	37.6
Proportion of Pools by Quality Class									
Class 1 ---------- percent	12.4	15.4	14.2	23.1	13.1	19.0	5.5	0.0	3.7
Class 2 ---------- percent	1.4	13.7	8.8	47.9	30.9	40.9	10.8	57.9	24.9
Class 3 ---------- percent	2.2	31.0	19.5	3.2	5.9	4.3	6.7	8.6	7.3
Class 4 ---------- percent	48.6	30.0	37.4	8.4	37.6	20.4	64.7	21.1	51.6
Class 5 ---------- percent	35.3	10.0	20.1	17.4	12.5	15.4	12.5	12.4	12.4
Proportion of Pool Bed Material									
Boulder ---------- percent	0.0	0.7	0.4	3.2	2.0	2.7	0.0	0.0	0.0
Rubble ---------- percent	0.5	2.7	1.8	6.1	2.7	4.7	5.5	6.6	5.7
Gravel ---------- percent	46.5	18.5	29.7	78.9	54.4	68.8	62.7	43.5	56.9
Sand-Silt ---------- percent	51.6	56.1	54.3	10.0	21.1	14.6	18.7	47.9	27.4
Vegetation --------- percent	0.0	22.0	13.2	0.2	19.8	8.3	0.4	0.3	0.4
Other ---------- percent	1.3	0.0	0.5	1.6	0.0	0.9	12.9	1.7	9.6
Proportion of Riffles by Quality Class									
Class 1 ---------- percent	73.1	53.6	70.4	63.4	26.5	58.0	41.9	8.7	40.5
Class 2 ---------- percent	9.1	19.8	10.6	10.8	15.5	11.5	7.05	18.9	14.2
Class 3 ---------- percent	7.8	13.0	8.5	8.2	29.6	11.3	10.95	42.6	22.8
Class 4 ---------- percent	10.1	13.7	10.6	17.6	28.4	19.2	15.00	29.9	22.6
Proportion of Riffle Velocity by Quality Class									
Class 1 ---------- percent	87.8	34.4	62.2	59.7	29.7	48.5	35.2	18.8	27.3
Class 2 ---------- percent	12.2	30.0	20.7	27.4	37.8	31.3	17.6	37.5	27.3
Class 3 ---------- percent	0.0	30.6	14.6	11.3	29.7	18.2	47.1	40.6	43.9
Class 4 ---------- percent	0.0	5.0	2.4	1.6	2.7	2.0	0.0	3.1	1.5
Proportion of Riffle Bed Material									
Gravel ---------- percent	96.1	54.1	90.3	68.7	85.2	71.1	79.5	76.8	78.7
Rubble ---------- percent	0.0	11.5	1.6	29.7	9.4	26.7	0.0	17.0	5.1
Bedrock ---------- percent	0.0	0.9	0.1	0.7	0.5	0.7	5.8	6.2	5.9
Silt ---------- percent	3.9	33.6	8.0	0.9	4.9	1.5	14.6	0.0	10.2
Proportion of Bank Cover by Vegetative Types									
Forest ---------- percent	0.0	0.0	0.0	1.2	0	0.6	21.0	34.0	27.0
Brush ---------- percent	29.4	32.1	31.3	35.6	34.6	35.1	25.8	24.5	25.2
Grass ---------- percent	19.6	62.9	49.6	27.6	46.8	37.0	19.3	23.6	21.5
Open ---------- percent	51.0	5.1	19.1	35.6	18.6	27.3	33.9	17.9	26.5
Stable Banks ---------- percent	8.8	35.3	27.2	37.0	66.0	50.9	29.0	40.6	34.5
Undercut Banks --------- percent	15.7	51.9	40.9	54.5	16.7	36.3	22.6	17.0	20.0
Unstable Banks --------- percent	75.5	12.7	31.9	8.5	17.3	12.7	48.4	42.4	45.7

Table 9. Summary of American River, Olds River and Roslyn Creek Fish Habitat and Stream Drainage Characteristics, 1978.

6.5 surface hectares or 16.1 surface acres (62.4% pool and 37.6% riffle) with a 22 cm (8.7 in) mean depth. Riffle bed material of the above waters was 78.7% to 90.3% gravel with a majority of the stream banks either stable or undercut.

Monthly flow readings for Buskin River, Salonie Creek and the above waters (Figures 5, 6, and 7) indicate the highest flow occurred in Salonie Creek (14.9 cms or 532 cfs) and the lowest in Roslyn Creek (0.4 cms or 14 cfs). Generally speaking, stream flows were high in May, August, and October, and low during the winter.

Analysis of monthly water samples from American River, Buskin River, Olds River, Salonie Creek, and Roslyn Creek (Table 10) indicates total ranges for hardness ($CaCO_3$), total alkalinity ($CaCO_3$), dissolved oxygen, and pH were 6-26 ppm, 10-34 ppm, 11.0-13.5 ppm and 6.4-6.7 units, respectively.

Temperature data for the above waters (Table 11) indicate the lowest number of temperature units occurred in Olds River (1,410) and the highest in Buskin River (1,822). Daily high temperature (15.3°C) occurred in Roslyn Creek during August and low (-1.0°C) occurred in Olds River during December.

Sport Fish Harvest Estimates:

Sport Fish postal survey harvest estimates for northeast Kodiak Island are not presented, as time and money were not available to reprogram data for the new computer system. These data will be computed by hand as time permits and included in 1980 report.

Creel censuses conducted at weir camps on southwest Kodiak Island and Afognak Lake on Afognak Island indicate fishing effort and harvest were low in relation to magnitude of available fish (Tables 12 and 13). Fishing quality in all waters was considered excellent as anglers usually released more fish than they retained. Karluk River received the most fishing pressure (Table 12) where a minimum of 376 anglers fished approximately 7,000 hours. Total sport harvest for Karluk was estimated at 104 steelhead, 29 rainbow trout, 135 Dolly Varden, 256 coho salmon, 328 chinook salmon, 116 sockeye salmon and three pink salmon.

Age 1.1 chinook salmon from the 1976 fry plant (n=22,500) were not observed during creel and cursory weekend censuses at Pasagshak River (Lake Rose Tead).

Assessment and Inventory of Anadromous Fish Populations:

Fish escapement estimates through Karluk Lagoon weir between May 20 and October 23 were comprised of 9,795 chinook salmon, 1,052 steelhead kelts, 12,089 coho salmon, 948 upmigrant adult steelhead, 1.38 million pink salmon and 0.36 million sockeye salmon. Table 14 presents weekly counts of the former three species while Tables 15 and 16 display the sex and age-growth composition of chinook and steelhead.

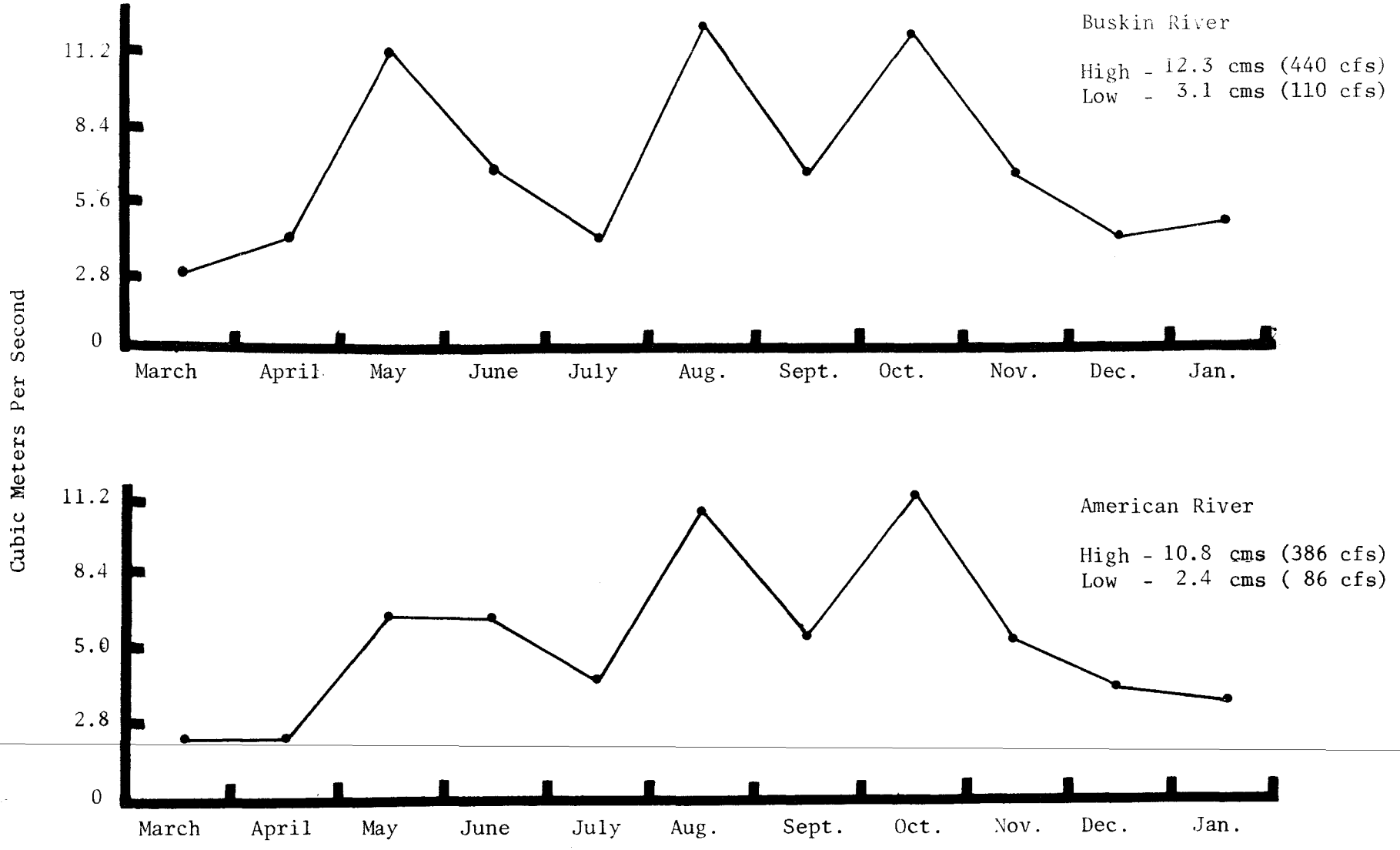


Figure 5. Flow Readings for American River and Buskin River March, 1978 through January, 1979.

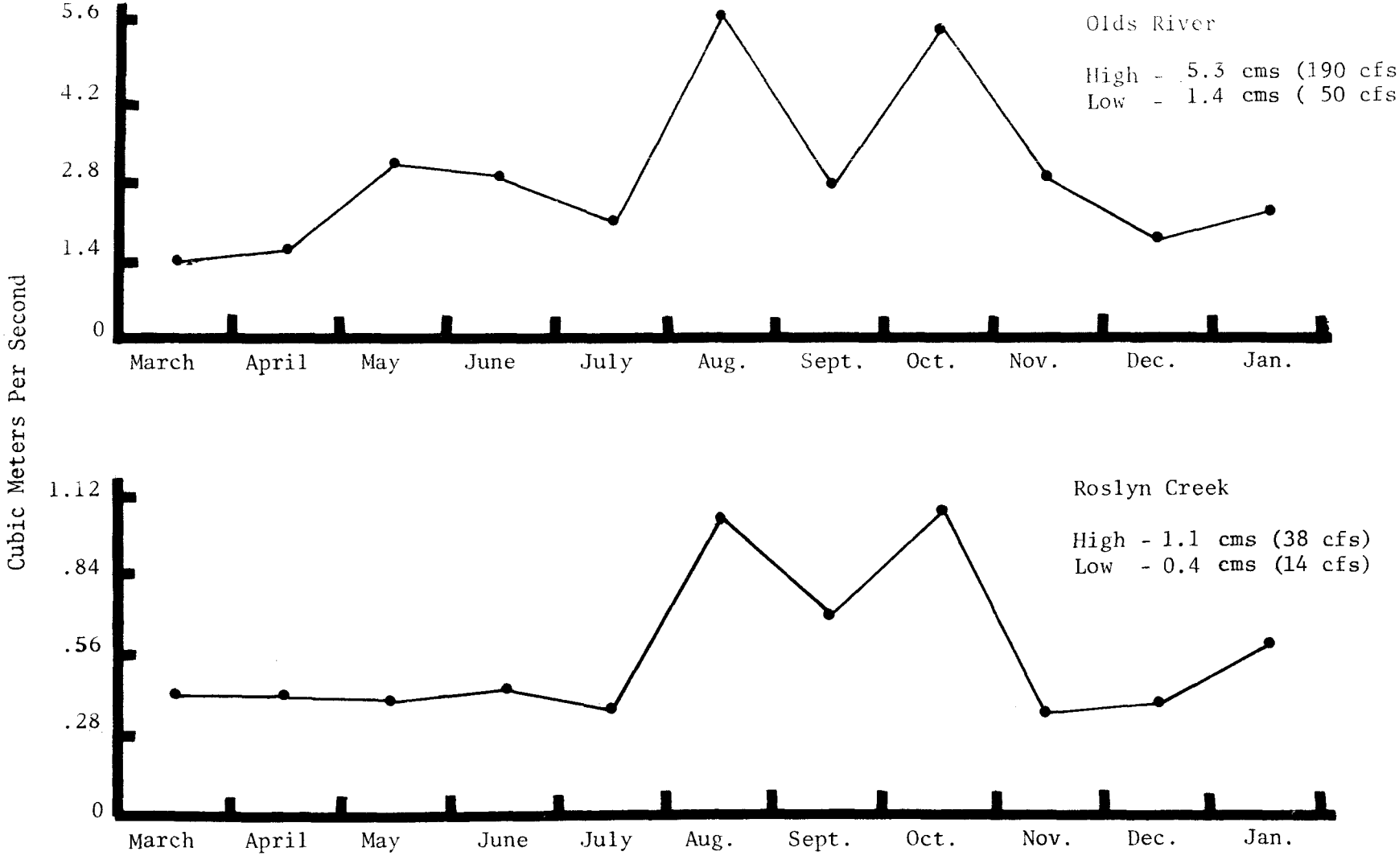


Figure 6. Flow Readings for Roslyn Creek and Olds River March, 1978 through January, 1979.

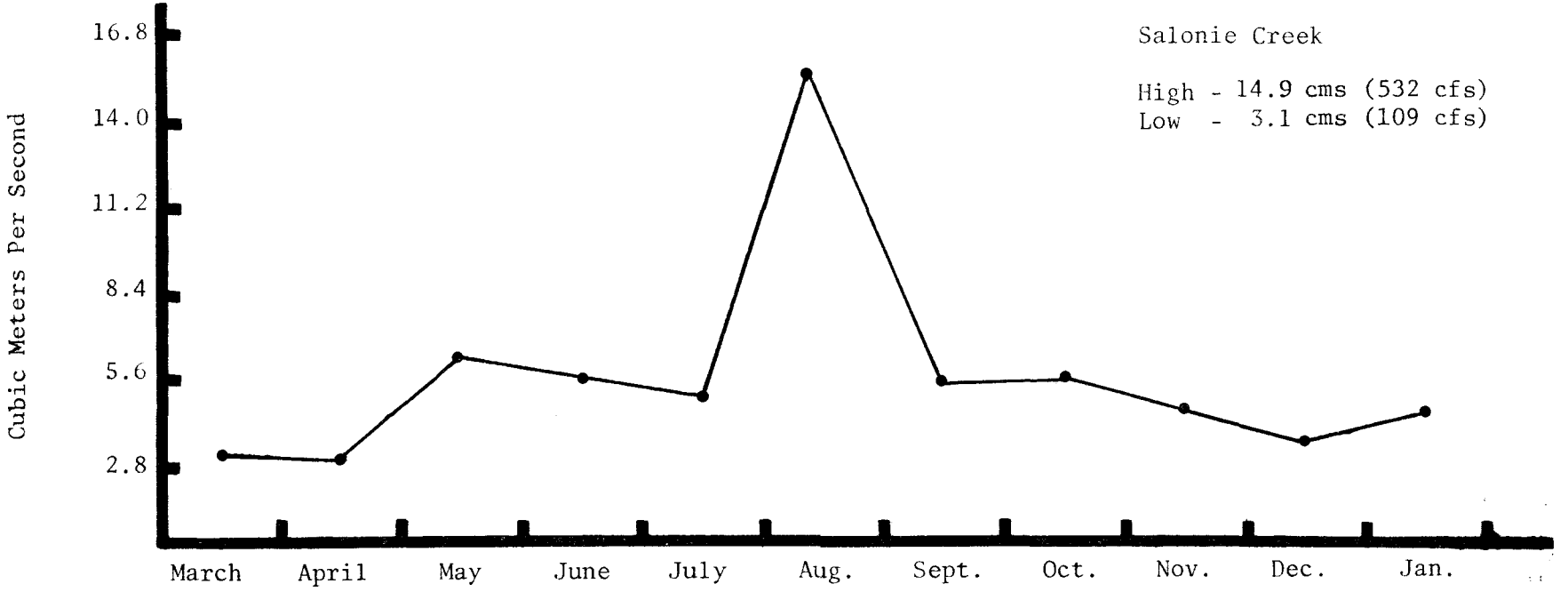


Figure 7. Flow Readings for Salonie Creek March, 1978 through January, 1979.

Table 10. Water Characteristics of Five Kodiak Streams Sampled Monthly, March 1978 - January 1979.

Stream	Dissolved Oxygen (ppm) Mean	Dissolved Oxygen (ppm) Range	Total Hardness (ppm) Mean	Total Hardness (ppm) Range	Total Alkalinity (ppm) Mean	Total Alkalinity (ppm) Range	pH Mean	pH Range
American	12.2	11.5-13.0	13.6	10-17	19.8	16-20	6.5	6.2-7.0
Buskin	12.6	11.0-13.5	11.9	8-15	15.9	12-20	6.6	6.3-7.0
Olds	12.5	11.0-13-5	10.2	8-12	18.8	17-20	6.4	6.2-6.7
Roslyn	12.5	11.0-13.5	9.0	6-10	13.0	10-16	6.5	6.2-6.7
Salonie	12.5	11.5-13.5	16.8	10-26	25.0	20-34	6.7	6.5-7.0

Table 11. Temperature Data for Five Kodiak Streams as Determined by Ryan Recording Thermographs March 1, 1978 through December 31, 1978.

Temp°C	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Total*
Stream: American River											
TU**	113.0	131.5	122.5	189.0	185.0	216.0	175.0	144.0	121.5	111.5	1,509.0
High	6.5	8.0	8.0	9.5	9.5	11.0	8.0	6.0	5.5	5.0	11.0
Low	1.0	3.0	2.0	3.0	4.0	5.5	4.0	4.0	3.5	2.5	1.0
Mean	3.6	4.4	4.0	6.3	6.0	7.2	5.8	4.6	4.0	3.6	
Stream: Buskin River											
TU**	44.2	102.8	156.0	267.1	347.5	398.6	295.3	158.8	43.9	8.4	1,822.6
High	2.0	4.4	6.1	12.2	12.2	14.4	11.7	7.8	3.9	1.1	14.4
Low	1.0	2.2	4.4	6.7	10.6	11.7	8.3	3.9	0.0	0.0	0.0
Mean	1.4	3.4	5.0	8.9	11.2	12.9	9.8	5.3	1.4	0.3	
Stream: Olds River											
TU**	74.5	103.5	136.5	181.5	215.0	269.5	217.5	132.0	56.5	24.2	1,410.7
High	5.5	7.5	7.5	11.5	12.5	12.5	10.0	7.0	3.5	1.5	12.5
Low	0.0	0.5	2.0	3.5	4.0	5.0	5.5	2.0	0.0	-1.0***	-1.0
Mean	2.4	3.4	4.4	6.0	6.9	8.7	7.2	4.3	1.9	0.8	
Stream: Roslyn Creek											
TU**	82.5	132.5	169.8	213.4	262.9	323.8	240.3	153.4	61.2	14.7	1,654.5
High	6.0	9.5	9.5	13.6	14.7	15.3	11.9	7.5	3.9	1.7	15.3
Low	0.5	1.0	3.0	3.9	6.1	8.1	6.4	3.0	0.0	-0.6	-.06
Mean	2.7	4.4	5.5	7.1	8.5	10.4	8.0	4.9	2.0	0.5	
Stream: Salonie Creek											
TU**	111.0	145.0	135.8	163.3	158.4	181.2	164.5	149.5	116.5	110.0	1435.2
High	7.0	9.0	7.0	9.5	9.0	9.0	8.0	6.5	5.0	4.5	9.0
Low	1.5	3.0	3.0	3.5	4.0	4.0	4.0	3.5	3.5	3.0	1.5
Mean	3.6	4.8	4.4	5.4	5.1	5.8	5.5	4.8	3.9	3.5	

* Negative temperatures are considered 0 temperature units and therefore not deducted from total temperature units.

** TU= Temperature Units

*** Temperature was below 0.

Table 12. Creel Census Estimates From Akalura, Ayakulik, Dog, Afognak, Olga and Karluk River Systems, 1978.

Area	Number of Anglers	Total Days	Total Hours	Steelhead		Rainbow Trout		Dolly Varden		Coho		Chinook		Sockeye		Pink	
				Rel.	Ret.	Rel.	Ret.	Rel.	Ret.	Rel.	Ret.	Rel.	Ret.	Rel.	Ret.	Rel.	Ret.
Afognak River	81	206	688	6	1	53	59	233	101	82	222	0	0	22	10	174	25
Akalura	4	24	160	1	1	0	0	130	70	0	0	0	0	2	10	31	8
Ayakulik	19	89	370	27	3	6	0	6	20	0	0	65	9	5	3	0	0
Dog Salmon R.	15	20	40	0	1	52	13	7	1	0	0	0	0	4	0	0	0
Karluk River																	
Lagoon	236*	927	5,155	120**	22**	70	18	429	39	27	3	268	249	93	110	45	3
Portage (Fly-ins)	140	416	1,791	297***	64***	89	11	2,157	96	136	43	44	79	7	6	2	0
Lodge	...	...	...	210	18	...	...	...	...	660	210	360	70	...	...	...	...
Olga Creek	15	16	46	0	0	120	28	62	3	0	0	0	0	0	0	0	0

Ret. = Retained

Rel. = Released

* Includes data from 124 float anglers that were censused at the lagoon.
** 97 released and 20 retained in the spring fishery.
*** 2 released and 0 retained in the spring fishery.

Table 13. Fish Escapement Counts Through Weirs on Kodiak and Afognak Islands, 1978.

River	Sockeye Salmon	Chinook Salmon	Pink Salmon	Chum Salmon	Coho Salmon	Steelhead Trout
Afognak	52,701	...	48,249	...	5,631	...
Akalura	1,020	...	1,127	...	47*	...
Ayakulik	132,864	4,739	1,000,000	7	1,705**	...
Dog Salmon	142,281	143	217,502	2,033	2,500	...
Karluk Lagoon	360,935	9,795	1,380,792	32	12,089	948***

* Weir pulled August 25; therefore, total coho escapement was not counted.
** Weir pulled August 21; therefore, total coho escapement was not counted.
*** An additional 1,052 steelhead kelts moved down through the weir.

Table 14. Summary of Chinook, Coho and Steelhead Enumerated through Karluk Lagoon Weir, 1978.

Period	Chinook		SH Kelts		Up SH		Coho	
	No.	%	No.	%	No.	%	No.	%
May 20 - 22	130*	1.3	1	0.1				
May 23 - 29	414	4.2	0	0.0				
May 30 - June 5	781	8.0	2	0.2				
June 6 - 12	2,394	24.4	121	11.5				
June 13 - 19	2,179	22.2	475	45.2				
June 20 - 26	1,752	17.9	81	7.7				
June 27 - July 3	1,017	10.4	16	1.5				
July 4 - 10	254	2.6	6	0.6				
July 11 - 17	251	2.6	24	2.3				
July 18 - 24	243	2.5	70	6.7				
July 25 - 31	131	1.3	34	3.2				
August 1 - 7	64	0.7	13	1.2			1	
August 8 - 14	73	0.7	84	7.9	1	0.1	2	
August 15 - 21	68	0.7	94	8.9	55	5.8	5	0.1
August 22 - 28	34	0.3	14	1.3	52	5.5	5	
August 29 - Sept. 4	7	0.1	9	0.9	24	2.5	13	
Sept. 5 - 11**	3	0.1	8	0.8			1,568	13.0
Sept. 12 - 18**							3,412	28.2
Sept. 19 - 25**					282	29.7	822	6.8
Sept. 26 - Oct. 2					21	2.2	195	1.6
Oct. 3 - 9					13	1.4	877	7.3
Oct. 10 - 16					161	17.0	2,232	18.5
Oct. 17 - 23					399	35.8	2,957	24.5
	9,795	100.0	1,052	100.0	1,008	100.0	12,089	100.0

* Includes 50 chinook estimated in river when weir completed on May 20.

** One-third of weir pulled on Sept. 5 due to pink salmon carcass accumulations and replaced on Sept. 25. Salmon estimates were made on the basis of 10-minute counts each hour between 6 a.m. and 12 p.m. Visibility was poor.

Table. 15. Age, Sex, and Size Composition of Karluk River Chinook Salmon, 1978.

Age Class	Males						Females						Total	%
			Length (mm)		Weight(kg)				Length(mm)		Weight(kg)			
	n	%	$\bar{x}$	±SD	$\bar{x}$	±SD	n	%	$\bar{x}$	±SD	$\bar{x}$	±SD		
1.1	1	1.1	440	0.0	.9	0.0	0						1	0.4
1.2	3	3.2	683	66.5	3.4	0.2	0						3	1.3
1.3	24	24.9	848	50.8	7.7	2.0	32	23.2	830	25.9	7.9	1.5	56	24.2
1.4	62	66.7	941	51.7	10.6	1.7	105	76.1	916	49.4	10.3	1.6	167	72.3
1.5	3	3.2	883	55.1	8.3	1.6	1	0.7	1029	0.0	...	...	4	1.8
													231*	100.0

* 60 fish sampled at Karluk Lagoon Weir
84 fish sampled from anglers creels at Portage
87 fish sampled from anglers creels at Karluk Lagoon

n = 231

Table 16. Length, Age and Sex Composition of Steelhead Retained by Karluk River Anglers, September and November 1978.

Age	Brood* Year	Males				Females				Total	
		n	%	Length (mm) $\bar{x}$	±SD	n	%	Length (mm) $\bar{x}$	±SD	n	%
2.1	1974	7	41.2	553	31.6	5	13.5	558	48.7	12	22.2
2.2	1973	5	29.4	666	84.2	22	59.5	679	38.3	27	50.0
2.2S	1972	1	5.9	760	0.0	1	2.7	750	0.0	2	3.7
2.1S1	1972	3	17.6	757	60.3	3	8.1	670	72.5	6	11.1
2.2S1	1971	1	5.9	800		6	16.2	771	28.6	7	13.0
		17	100.0			37	100.0			54	100.0

* Brood Year = Year adults returned to stream

Age 1.3 and 1.4 chinook composed 96.5% of the 231 fish sampled while Age 1.1, 1.2 and 1.5 comprised the remaining 3.5%. The dominant 1.4 age class contained 62 males ($\bar{x}$ ln. = 941 mm or 37.0 in) and 105 females ($\bar{x}$ ln. = 916 mm or 36.1 in). Age class 1.3 males (n=24) averaged 848 mm (33.4 in) and females (n=32) averaged 830 mm (32.7 in) in length.

Steelhead sampled from Karluk River (n=54) contained five age classes with sexes of a given age similar in size (Table 15). The dominant 2.2 age class contained five males ($\bar{x}$ ln. = 666 mm or 26.2 in) and 22 females ($\bar{x}$ ln. = 679 mm or 26.7 in), while age 2.1 contained seven males and five females that respectively averaged 553 mm (21.8 in) and 558 mm (22.0 in) in length (Table 16). All fish spent two years in fresh water while 27 returned to spawn a second or third time.

Six of the original 259 steelhead kelts tagged at Karluk Lagoon in June 1977 were recovered during September and October 1978. Table 17 presents size, sex, and age data for these fish and Figures 8 and 9 show the scale features of Karluk steelhead which have spawned, migrated to the ocean, and returned after 15 months. Analysis of the scale growth pattern indicates clear fresh water and ocean annuli through the first spawning with an evident spawning check; however, inspection of post spawning scale growth indicates the ocean winter annulus is obscure and may be overlooked if the fish were not tagged and of known age. It is also interesting to note that five of the six fish recaptured were females and the growth rate (Table 17) during ocean residency was only 34-164 mm or 1.3-6.5 in (n=4).

A total of 137 Dolly Varden, 886 coho salmon smolt, and 7,400 sockeye salmon smolts were enumerated through Lake Genevieve weir from May 15 through June 25, 1978. The sockeye outmigration (Figure 10) was bimodal with peak movements occurring May 22-28 and June 12-18. Age-growth analysis of 193 sockeye smolt indicated all fish were age 1.0 with a mean length of 84.5 mm (3.3 in) and weight of 5.2 grams (0.2 oz). The major coho smolt migration occurred May 22-28 and terminated by June 18. All smolts (n=108) were age 2.0 with a respective mean length and weight of 135.2 mm (5.3 in) and 8.3 grams (0.3 oz).

Several thousand gallons of JP-5 fuel were spilled in the Lake Genevieve drainage May 22-28 which subsequently polluted the lake and lower Buskin River. Coho in the smolt trap appeared normal; however, sockeye tended to jump and swirl in a circular fashion, apparently ill from the fuel. Sport anglers also reported Lake Genevieve rainbow trout unpalatable due to a strong oil flavor.

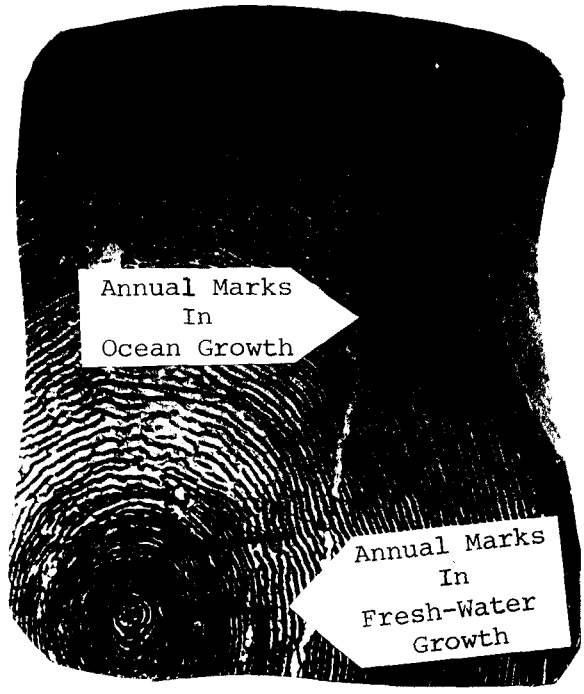
During late August approximately 300 adult sockeye negotiated Lake Genevieve fish barrier and subsequently spawned in the lake.

Peak salmon escapement estimates for 17 Kodiak Island streams (Table 18) indicated 280,301 pink salmon, 17,650 chum salmon, 28,301 sockeye salmon and 6,007 coho salmon spawned.

Table 17. Summary of Tagged Steelhead Recovery Data, Karluk River, 1978.

		Tagging Data			Recovery Data			
Tag No.	Sex.	Date	Age	Ln(mm)	Date	Age	Ln(mm)	Ln Increase**
22	F	June 1977	2.2S	695	Sept. 22, 1978	2.2S1	768	75
52	F	June 1977	R.2S	658	Oct. 10, 1978	2.2S1	733	75
203	F	June 1977	2.1S	575	Oct. 12, 1978	2.1S1	609	34
262	F	June 1977	2.2S	656	Oct. 23, 1978	2.2S1	820	164
279*	M	June 1977	2.2S	624	Oct. 1978	2.2S1	...	...
291*	F	June 1977	2.1S	546	Oct. 1978	2.1S1	...	...

* Tags were returned without length data or scale sample.
** Ln. Increase (mm) = amount of growth since fish was tagged.



Female Steelhead, Tag No. 262
06/77, Age 2.2S, Ln. 656 mm

Female Steelhead, Tag No. 262
10/78, Age 2.2S1, Ln. 820 mm

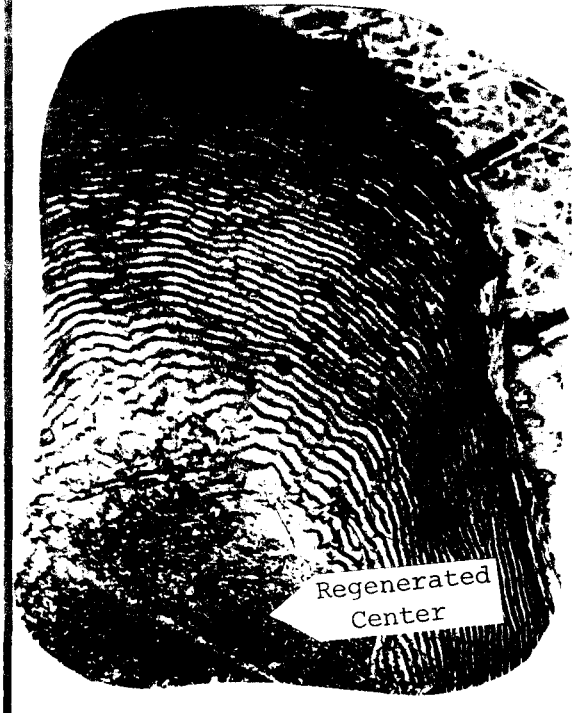
Female Steelhead, Tag No. 203
06/77, Age 2.1S, Ln. 575 mm

Female Steelhead, Tag No. 203
10/78, Age 3.1S1, Ln. 609 mm

Figure 8. Features of Steelhead Scales Immediately After Spawning and Following Its Return to Fresh Water.

Female Steelhead, Tag No. 52
06/77, Age ? .2S, Ln. 658 mm

Female Steelhead, Tag No. 52
10/78, Age 2.2S1, Ln. 733 mm



Female Steelhead, Tag No. 22
06/77, Age ? .2S, Ln. 695 mm

Female Steelhead, Tag No. 22
10/78, Age 2.2S1, Ln. 768 mm

Figure 9. Continued. Features of Steelhead Scales Immediately After Spawning and Following Its Return to Fresh Water.

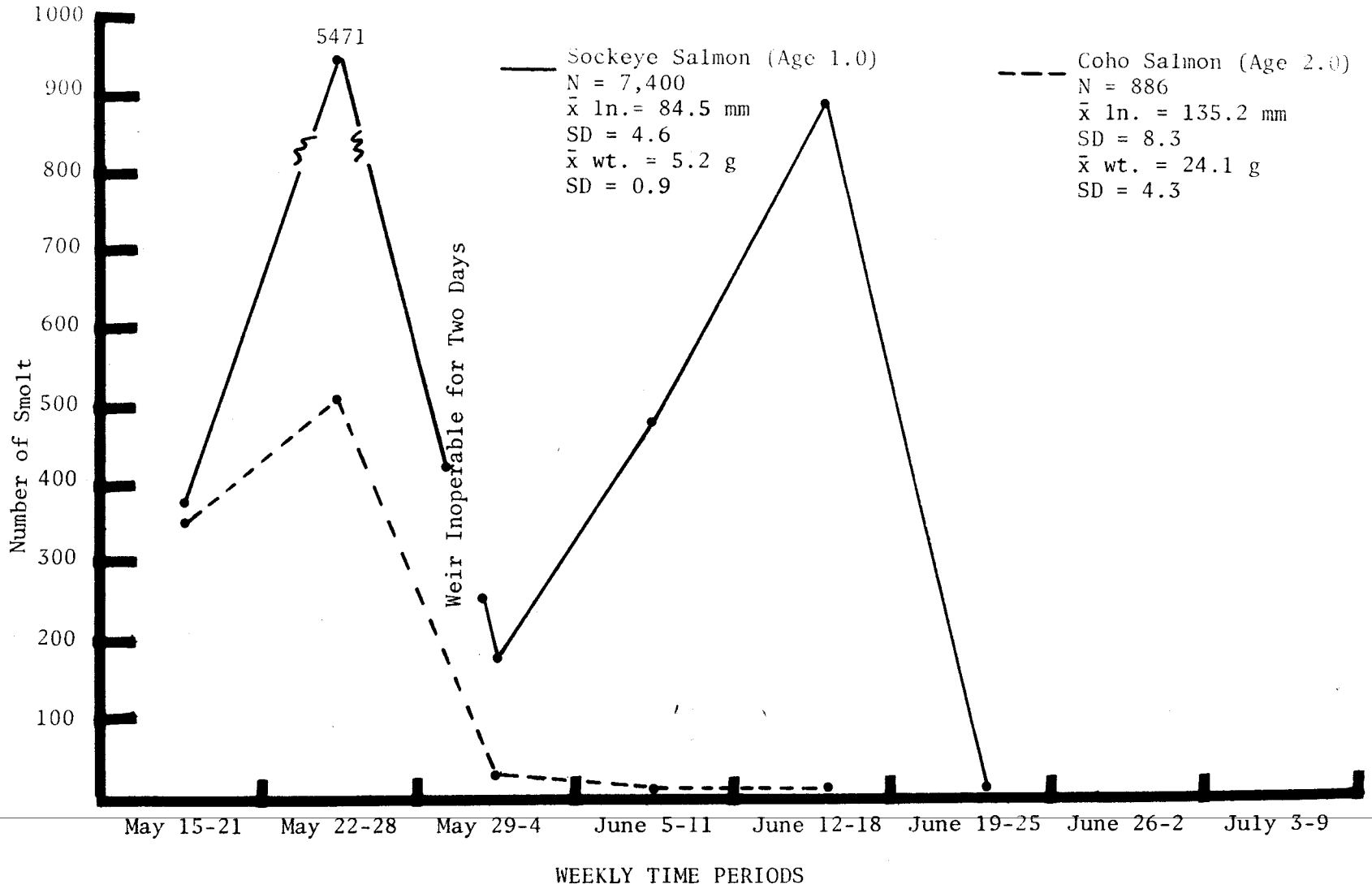


Figure 10. Sockeye Salmon and Coho Salmon Smolt Escapement Counts by Weekly Periods at Lake Genevieve Weir, 1978.

Table 18. Peak Salmon Escapement Estimates, N.E. Kodiak Island, 1978

System	Chum Salmon		Coho Salmon		Pink Salmon		Sockeye Salmon	
	Date	Escpmt.***	Date	Escpmt.*	Date	Escpmt.***	Date	Escpmt.
American	August 25	4,650	October 26	705	August 28	28,900	NA	
Buskin	NC		October 31	886	August 25	81,000	July 28** September 6	4,201
Chiniak	NC		October 27	51	August 21	330	NA	
Hurst	August 18	2,000	November 9	183	August 15	29,000	NA	
Kalsin	NC		October 20****	292	July 26	4,400	NA	
Monashka	NC		October 24	13	August 24	6,500	NA	
Myrtle	NC		NC		August 21	600	NA	
Olds	August 21	6,000	October 27	1,090	August 28	65,000	NA	
Pasagshak	NC		October 19	1,441	August 21	1,800	August 21	2,100
Pillar	NC		October 24	74	August 24	3,800	NA	
Roslyn	NC		October 22	406	August 21	24,000	NA	
Russian	NC		October 31	22	August 25	900	NA	
Salonie	NC		October 31	261	August 25	700	NA	
Saltery	August 18	5,000	November 8	543*****	Aug. 18	30,000	July 31	22,000

Table 18. (Cont.) Peak Salmon Escapement Estimates, N.E. Kodiak Island, 1978

System	Chum Salmon Date	Chum Salmon Escpmt.***	Coho Salmon Date	Coho Salmon Escpmt.*	Pink Salmon Date	Pink Salmon Escpmt.***	Sockeye Salmon Date	Sockeye Salmon Escpmt.
Sargent	NC		October 23	35	August 25	2,000	NA	
Twin	NC		October 27	5	August 21	300	NA	
#410	NC		NC		August 21	1,400	NA	
Total		17,650		6,007		280,630		28,301

* Foot survey
** Boat survey
*** Aerial survey
**** Includes 100 SS observed in Kalsin Pond
***** Outlet only

NC = No count
NA = Not applicable

Table 19 presents species composition and age-growth data for fish sampled at Lake Rose Tead, American River, Buskin River, Olds River, Salonie Creek and Roslyn Creek. Multiple age classes of Dolly Varden (1.0-4.0) and juvenile coho salmon (0.0 and 1.0) were captured in all waters except American River. Juvenile steelhead trout (n=15) were captured in Buskin River and threespine stickleback and sculpins were captured or observed in all waters sampled.

DISCUSSION

Lake and Stream Surveys:

Twelve of the 18 lakes surveyed on Afognak Island contain natural Dolly Varden populations which are of sufficient size to support recreational sport fisheries (Table 4). Three of the fish producing waters (No. 13576-A, No. 13581, and No. 13586) are shallow (1.8-2.4 m or 6.0-8.0 ft deep) and subject to winter kill; consequently, fish production is likely to be marginal and cyclic. Two of the barren lakes (No. 13574 and No. 13585) are suitable for fish production but should be studied further to confirm initial survey results. Also, more physical and biological data should be collected to determine species of fish suitable for stocking and optimum stocking densities. Lake No. 18577 is barren of fish but has poor fish development or production potential as it is remote and inaccessible, very high alpine (457 m or 1500 ft elevation) and has low water quality (total hardness = 0.0 ppm and total alkalinity = 4.0 ppm).

Zero rainbow trout captured in Waterfall Lake (No. 13578) during 1,441 gill net and minnow trap hours of sampling (Table 4) indicates the rainbow trout population is either nonexistant or very small. However, rainbow trout do exist in the lake outlet below the 20-foot falls as U.S. Forest Service personnel captured eight juvenile fish in this area August 16, 1978 (letter dated August 16, 1978 from Ralph Browning, U.S. Forest Service, Fishery Biologist, Kodiak, Alaska). Since adult trout were not captured or observed the possibility exists that these fish may be juvenile steelhead.

The physical and chemical data collected from Kodiak streams (Tables 9, 10, 11 and Figures 5, 6, and 7) is impossible to correlate with annual fish reproduction until stream surveys and specific fish survival information are completed and analyzed.

Assessment and Inventory of Anadromous Fish Populations:

Fish escapements through fish counting facilities on Kodiak and Afognak Islands were sufficient to support the current sport fisheries (Tables 12 and 13). In general, sport fishing effort was low and fish escapements were high; however, effort has been increasing on Karluk River, i.e., Murray and Van Hulle (1975) noted 114 angler days effort at Karluk Lagoon compared to 927 angler days this year. Therefore, this fishery should be closely monitored to protect the lesser but important steelhead and chinook salmon runs.

Karluk River steelhead apparently have two distinct types of behavior following spawning. Some spawners return the first fall after spawning (Murray and Van Hulle, 1978) while others remain in the ocean for 15 months (Table 17 and Figures 8 and 9). The obscure marine winter annulus that occurs after spawning undoubtedly results in some fish being incorrectly aged by one year.

The small run of Dolly Varden, coho and sockeye salmon that existed in Lake Genevieve prior to chemical rehabilitation (Murray and Van Hulle, 1972) have apparently reestablished themselves (Figure 10); however, threespine stickleback have not been observed or captured. A possible management alternative for this lake would be to land-lock a portion of the out-migrant sockeye smolt to create a kokanee fishery.

Lake Genevieve smolt escapements listed in Figure 10 cannot be used as an index to predict future adult fish returns as: (1) the oil spill probably resulted in delayed fish mortality, and (2) an undetermined number of fish moved downstream May 22 and 23 when the weir was inoperable.

Peak salmon excapement counts for 17 Kodiak Island streams (Table 18) were sufficient to sustain the traditional sport harvest.

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Table 19. Population Characteristics of Rearing Fish in Six Kodiak Area Waters as Defined by Minnow Traps, 1978

Location & Date	Trap Hours	Species	Age	n	Length (mm) $\bar{x}$	Length (mm) $\pm$SD
Buskin River						
July 7-10	570	SS	0.0	12	66.8	7.1
		SS	1.0	78	84.5	8.1
		SS	2.0	2	91.5	0.1
		SH	1.0	4	71.5	7.1
		SH	2.0	11	116.7	12.8
		DV	2.0	29	92.1	11.9
		DV	3.0	30	124.1	16.9
		DV	4.0	2	139.5	12.0
		SC	...	0	...	...
		TST	...	16	...	...
American River						
July 21-24	434	SS	...	0	...	...
		DV	1.0	35	10.9	6.8
			2.0	45	88.1	6.5
			3.0	7	111.0	9.1
Lake Rose Tead						
July 19	480	SS	0.0	105	48.5	9.1
		SS	1.0	17	81.5	10.6
		DV	1.0	5	79.2	9.6
			2.0	17	92.1	8.5
			3.0	19	125.3	10.1
			4.0	8	137.6	13.2
		RS	0.0	6	32.3	2.9
		TST	...	6	...	...
		SC	...	19	...	...
Salonie Creek						
July 11-12	445	SS	0.0	11	46.6	6.3
		SS	1.0	40	76.8	8.3
		DV	1.0	25	69.6	7.7
			2.0	55	83.4	15.4
			3.0	17	108.9	13.8
		SC	...	5	...	...

Table 19. (Cont.) Population Characteristics of Rearing Fish in Six Kodiak Area Waters as Defined by Minnow Traps, 1978

Location & Date	Trap Hours	Species	Age	n	Length (mm) $\bar{x}$	Length (mm) $\pm$SD
Roslyn Creek	552	SS	0.0	78	57.1	9.5
July 25		SS	1.0	58	89.8	9.0
		DV	1.0	1	51.0	...
			2.0	43	100.6	10.0
			3.0	11	117.5	18.5
			4.0	1	158.0	...
		SB	...	15	...	...
		SC	...	49	...	...
Olds River						
July 26	408	SS	0.0	5	57	...
			1.0	27	79.6	9.5
		DV	1.0	8	80.6	3.9
			2.0	18	98.4	11.8
			3.0	12	110.3	11.5
		TST	...	26	...	...
		SC	...	4	...	...

SS = Coho Salmon
DV = Dolly Varden
SH = Steelhead Trout
SC = Slimy Sculpin
TST = Threespine Stickleback
RS = Sockeye Salmon

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